Rhodora

JOURNAL OF

THE NEW ENGLAND BOTANICAL CLUB

Vol. 40. June, 1938. No. 474.

THE OSCILLATORIACEAE OF SOUTHERN MASSACHUSETTS[1]

FRANCIS DROUET

ALGAL works published during the past sixty-five years contain short lists of Oscillatoriaceae from southern Massachusetts,[2] the chief among which are those of Farlow, *Marine Algae of New England* (1891); Collins, RHODORA **2**: 41–52 (1900); Davis, Bull. U. S. Bur. Fish. 1911 (2): 795–833 (1913); Taylor and Hazen in Lewis, RHODORA **26**: 211–215 (1924); and Croasdale, *Fresh Water Algae of Woods Hole, Massachusetts* (1935). Other shorter papers are referred to in the list of species below. A small number of preserved specimens from the region has been distributed by Farlow, Anderson & Eaton in *Algae Am. Bor. Exsiccatae* and by Collins, Holden & Setchell in *Phycotheca Boreali-Americana*. These exsiccatae, the specimens upon which previous reports have been based, and other material cited in the present paper have come chiefly from the vicinity of Woods Hole. The freshwater algal habitats of this area are described by Fogg, RHODORA **32**: 147ff (1930), and by Croasdale, ibid.; the marine and brackish habitats by Davis, ibid. 1911 (1): 443–544 (1913), and by Taylor, *Marine Algae* (1937).

The comparative morphology of the group, first treated critically by Thuret, Ann. Sci. nat. VI Bot. **1**: 372–382 (1875), and further elaborated in a series of papers by Bornet, Thuret, Flahault, and Gomont, is summarized in a lucid manner in the introduction to

[1] Contribution from the Osborn Botanical Laboratory of Yale University and the Department of Botany, Marine Biological Laboratory.

[2] The Myxophyceae of Nantucket County will be treated in a separate publication and are therefore not referred to in the present paper. For a similar reason, the genus *Plectonema* Thur. ex Gom. is omitted here.

Gomont's 'Monographie des Oscillariées,'[1] Ann. Sci. nat. VII Bot. **15:** 263–368; **16:** 91–264 (1892). Recent work is reviewed by Geitler, Rabenh. Kryptogamen-Fl. **14** (1930–32). These authors make clear, among other things, that most species can be recognized with reasonable accuracy only when the organisms are found in non-hormogonial masses of considerable size and relatively pure state. Such determinable plant-masses, it is argued, develop only under certain limited combinations of physical, chemical, and biotic conditions; as these conditions change, the plant-mass may pass into the hormogonial state or disappear entirely. The determinable state may persist for a single day, or throughout a season, or even longer. The descriptions for taxonomic purposes will apply, therefore, only to the brief period of the life history during which the plant-mass is not in the hormogonial or dispersed states. In the species which he treated, Gomont attempted to define the limits of variation of each character during this determinable state: color and form of plant mass; color, diffluence, lamination, size, and reaction to chlor-zinc-iodine of the sheath; habit of the filaments and trichomes; shapes of apices of the trichomes; the degree of thickening of the outer wall of the apical cell; cell measurements; color and granulation of the protoplasm; and nature of the cross-walls. The recent literature contains frequent expressions of doubt as to the taxonomic importance of certain of the more variable characters referred to above. Such doubt in some cases may be well founded; in other cases it may be due to the lack of familiarity with the species concerned. It is to be regretted that these limits of variability have not yet been studied by pure culture methods; on the other hand, though such characters are generally regarded as extremely inconstant in other groups of plants and animals, I must confess myself unable except in rare instances to enlarge upon the limits of variability as described by Gomont.

For permanent preservation of the characters mentioned above, drying the material as quickly as possible without the aid of heat is recommended. The best preparations are secured when the material is reduced to the dried condition in the open air (in front of a shaded open window or electric fan) within an hour after it has been lifted from its habitat. In so drying, the shapes of the cells and even the protoplasmic characters of color and granulation are preserved.

[1] The International Botanical Congress of Vienna in 1905 established Gomont's 'Monographie' as the point of departure for nomenclature in the Homocystineae.

Mounts duplicated upon mica (or glass) and paper are to be preferred. Formalin, even in such low concentrations as 2% by volume in water, often produces granules and vacuoles not evident in the living protoplasm and seldom allows the original color of the plant mass or of the trichomes to be retained. If material preserved in formalin is dried in the preparation of herbarium specimens, such essential characters as size and shapes of cells are often sacrificed also, especially in the unsheathed forms. There are indications that preservation in liquid media affects the capacity of the sheath to react with chlor-zinc-iodine. Preserving fluids containing alcohol, acetic acid, glycerine, and salts of copper render most material valueless for taxonomic purposes.

For obvious reasons, citations of specimens in the list below have been restricted to herbarium material. The location of specimens in herbaria is indicated by means of the following abbreviations: D, my personal herbarium; F, Farlow Herbarium of Harvard University; Mo, Herbarium of the Missouri Botanical Garden; N, New York Botanical Garden; P, Herbarium of the University of Pennsylvania; S, Naturhistoriska Riksmuseet, Stockholm; T, Herbarium of Wm. Randolph Taylor; W, Herbarium of the Marine Biological Laboratory; Y, Herbarium of Yale University.

The keys presented here are admittedly cumbersome, but it is hoped that they will enable the worker to determine with accuracy whether or not his material can be placed in a species treated. I have not hesitated, wherever such a procedure seemed desirable, to incorporate literal translations of parts of original descriptions into the key. The term 'cell' is used throughout the paper as an English equivalent of Gomont's *articulum*, and 'cross-wall' an equivalent of Gomont's *dissepimentum*.

I am grateful to members of the staffs of the Osborn Botanical Laboratory, the Marine Biological Laboratory, the Farlow Herbarium, the New York Botanical Garden, and the Department of Botany of the University of Missouri for their generous cooperation during this work; to Prof. l'Abbé P. Frémy, Prof. L. Geitler, and Dr. G. Huber-Pestalozzi for comparing various specimens with authentic European material; to Prof. Wm. Randolph Taylor, Dr. Hannah T. Croasdale, Mr. Earl T. Rose, Prof. George J. Hollenberg, Prof. G. W. Prescott, Mr. C. M. Palmer, Mr. G. T. Velasquez, and many others cited as collectors of specimens here, who placed their collections at my dis-

posal and rendered numerous other courtesies; and to Prof. Taylor, Prof. A. W. Evans, and Prof. G. E. Nichols for suggestions concerning the manuscript during its preparation. Much of the work was pursued at Yale University with the aid of the Theresa Seessel Research Fellowship.

KEY TO GENERA

I. Trichomes more than one within the sheath; sheaths typically closed at the apices ..... Tribe I. VAGINARIEAE
  A. Trichomes few (1–5, rarely more) and loosely aggregated within the sheath
    1. Plant-mass aerial, subaerial, or submersed, compact, in some species impregnated with calcium carbonate or other foreign substances; sheaths hyaline or colored, in many species coloring blue when treated with chlor-zinc-iodine, definitely delimited, often lamellated, in most species not mucous; trichomes never capitate ..... *Schizothrix*
    2. Plant-mass submersed or subaerial, mucous; sheaths always hyaline, never coloring blue when treated with chlor-zinc-iodine, broad and often conspicuously lamellated, often entirely diffluent; trichomes attenuate and truncate or capitate at the apices .... *Hydrocoleum*[1]
  B. Trichomes numerous and closely aggregated within the sheath.—Plant-mass submersed, subaerial, or aerial, compact or gelatinous; sheaths always hyaline, in our species not coloring blue when treated with chlor-zinc-iodine, mucous and often entirely diffluent; trichomes rotund, attenuate, or calyptrate at the apices .... *Microcoleus*

II. Trichomes solitary within the sheath or without evident sheaths; sheaths not closed at the apices ..... Tribe II. LYNGBYEAE
  A. Plant-mass sufficiently coherent (in most species) to remain intact when lifted from its habitat; trichomes surrounded by evident sheaths or amorphous jelly
    1. Plant-mass characteristically submersed, rarely subaerial; sheaths definitely delimited, often lamellose, becoming mucous and diffluent only (if at all) in the hormogonial state ..... *Lyngbya*[2]
    2. Plant-mass aerial or subaerial, the interwoven and contorted filaments forming a compact stratum, from the surface of which arise upright or repent bundles of filaments; sheaths in the stratum distinct and never confluent, in the fascicles often mucous and confluent; trichomes never capitate with an enlarged apical cell, in some species calyptrate ..... *Symploca*[3]

[1] Species of Hydrocoleum, especially the marine forms, are often misplaced in the genera Symploca, Phormidium, and Oscillatoria.

[2] *Symploca Muscorum* and *Phormidium ambiguum*, when growing submersed, often produce distinctly lyngbyoid masses. Species of Plectonema, Scytonema, Tolypothrix, and Hapalosiphon, observed in unbranched or anheterocystous states, have often been confused with species of Lyngbya.

[3] If submersed, the plant-mass is a compact stratum or gelatinous mass of contorted filaments the sheaths of which are definitely delimited and seldom mucous. *Lyngbya aestuarii* when growing subaerially often produces upright fascicles from the stratum (f. *symplocoidea* Gom.). Species of Schizothrix, Fischerella, Scytonema, Tolypothrix, and Hapalosiphon produce similar fascicles under subaerial conditions.

3. Plant-mass submersed, subaerial, or in a few species aerial, compact; sheaths characteristically partially or wholly confluent into an amorphous jelly which in some species is impregnated with calcium carbonate or other foreign matter; trichomes not more than 12 μ in diameter, in several of the more common species capitate with an enlarged apical cell . . . . . *Phormidium*

B. Plant-mass mucous, rarely remaining intact when lifted from its habitat, submersed or subaerial; trichomes without evident sheaths or amorphous jelly

1. Trichomes not regularly and permanently spiraled throughout their entire lengths, always articulated (cross-walls evident without the application of stains or reagents), in many species straight, or variously curved and contorted, or spiraled at or for a short distance behind the apices . . . . . *Oscillatoria*
2. Trichomes more or less regularly and permanently spiraled throughout their entire lengths, conspicuously articulated, not evidently so, or not at all . . . . . *Spirulina*

Vaginarieae

Gom. ex Ann. Sci. nat. VII Bot. **15**: 290 (1892).

SCHIZOTHRIX Kütz. ex Gom., ibid. 292 (1892). *Hypheothrix* Kütz. ex Kirchn., Schizophyc. 67 (1900). *Symplocastrum* (Gom.) Kirchn., ibid. 68 (1900). *Inactis* Kütz. ex Kirchn., loc. cit. (1900).—The four subgenera are separated from each other according to the habit of the plant masses and the color of the sheaths. No specimens of the subgen. *Inactis* Gom. have appeared in the collections examined. It is to be expected that further collecting will discover a number of as yet unreported species of Schizothrix in the southern Massachusetts flora.

Key to Species

I. Small plants, aquatic, subaerial, or aerial, with prostrate habit of growth, filaments in which false branching is not common, and hyaline sheaths . . . . . Subgenus I. Hypheothrix (Kütz.) Gom. ex Ann. Sci. nat. VII Bot. **15**: 306 (1892).

Stratum almost fragile, blue-green, never incrusted with lime; filaments closely interwoven, lower portions unbranched and straight, upper portions falsely branched, the branches tortuous in habit; sheaths usually firm, erose at the margins, acuminate at the apices, in the lower portions wide and lamellose, coloring blue when treated with chlor-zinc-iodine; trichomes few within the sheaths, often single in the false branches, 1.5–3 μ in diameter, constricted at the cross-walls; cells up to 5 μ long; apical cell acute-conical . . . . . *S. arenaria*

II. Subaerial or aerial plants with filaments ascending in erect symplocoid fascicles from a prostrate stratum, the sheaths always hyaline . . . . . Subgenus II. Symplocastrum Gom., ibid. 314 (1892).

Stratum indefinitely expanded, blackish or olive-green; filaments in the basal stratum tortuous and intermeshed, in the fascicles more or less straight, erect, parallel, dichotomously and appressedly false-branched; fascicles rigid, spiniform, erect, to 3 cm. or more high; sheaths

cylindrical, firm, lamellose, erose or smooth on the margins, acuminate at the apices, coloring blue when treated with chlor-zinc-iodine; trichomes pale blue-green, few or solitary within the sheath, parallel, evidently constricted at the cross-walls, 3–6 μ in diameter; cells subquadrate to twice as long as wide, 4–11 μ long; protoplasm coarsely granular; apical cell truncate-conical ..... *S. Friesii*

III. Plant mass terrestrial or rarely aquatic, a prostrate stratum from which, in several species, arise erect or repent symplocoid fascicles; sheaths of mature filaments colored ..... Subgenus III. CHROMOSIPHON Gom., ibid. 318 (1892).

Stratum indefinitely expanded, dark violet or brownish; filaments more or less elongate, subdichotomously and falsely branched, the branches divaricate, much contorted below, more or less parallel and agglutinated into tortuous repent fascicles above; sheaths brown- or purplish-red, with acuminate hyaline apices, firm, very wide and conspicuously lamellose, irregular or erose on the margins, coloring blue when treated with chlor-zinc-iodine; trichomes pale blue-green, often more or less numerous within the sheath, in most collections constricted at the cross-walls, 6–8 μ in diameter; cells subquadrate to twice as long as wide; protoplasm coarsely granulose in all except the apical cell; apical cell conical, often very acutely so ..... *S. purpurascens*

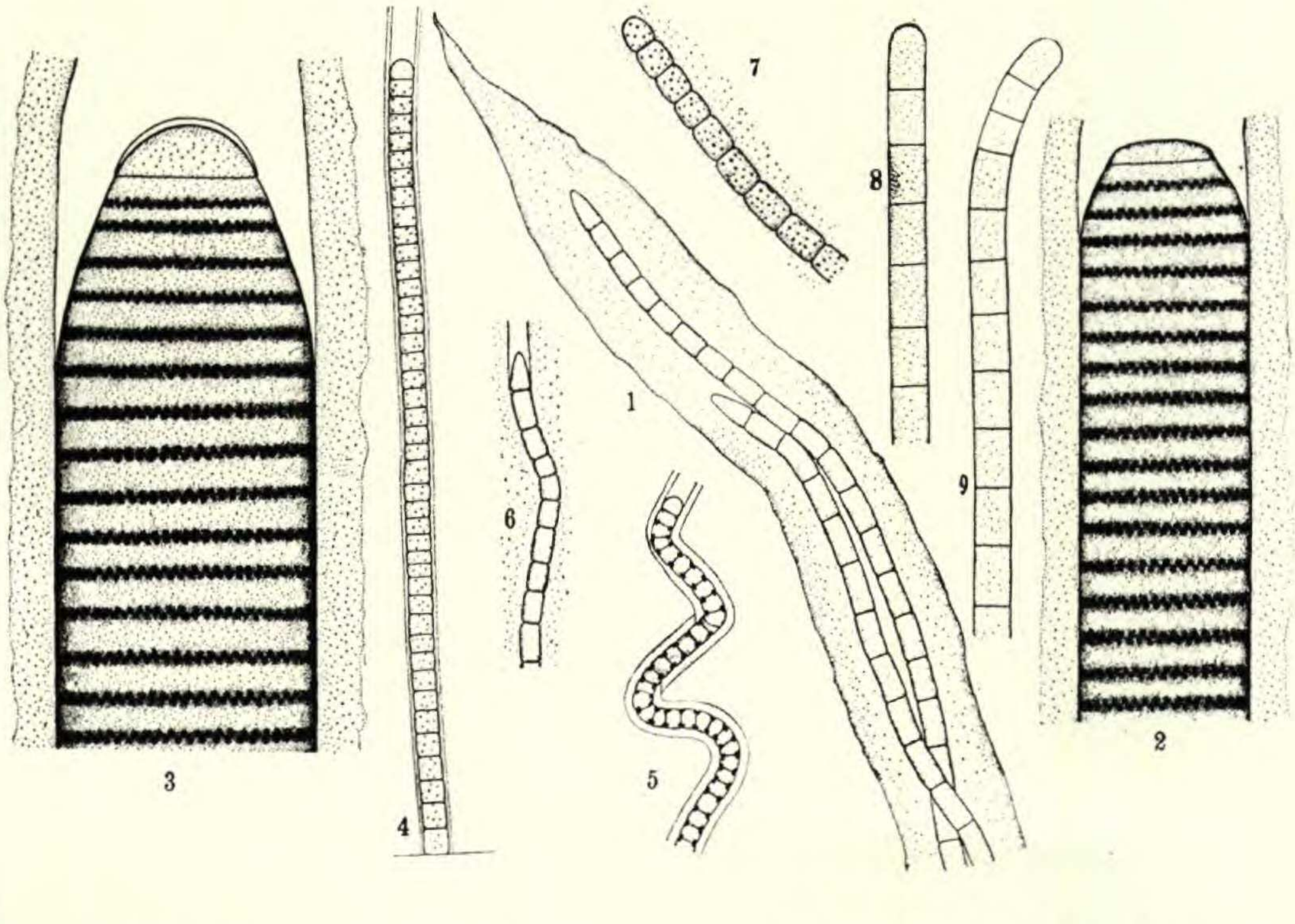
SCHIZOTHRIX ARENARIA (Berk.) Gom., Ann. Sci. nat. VII Bot. **15**: 312, pl. viii, f. 11, 12 (1892). *S. Friesii* of Croasdale, Fresh Water Alg. Woods Hole, Mass., 21 (1935), in part, not Gom.—*Fig. 1.* This is an apparently frequent alga of denuded soil. Smith in *Fresh-water Algae of the United States* (1933) does not cite the species for the United States, though Gomont, ibid. 313, mentions a specimen collected by Setchell in this country. Specimens seen: FALMOUTH: on denuded ground at south end of Park Street, Woods Hole, *Drouet 1929*, 25 Aug. 1936 (D, F, S, T, Y); clay bank near entrance to Gansett Estate, Woods Hole, *Drouet 1217*, 5 Aug. 1934 (D, W); on clay bank, side of road to Quisset, *G. T. Moore*, 20 July 1898 (W).

SCHIZOTHRIX FRIESII (Ag.) Gom., Ann. Sci. nat. VII Bot. **15**: 316, pl. ix, f. 1, 2 (1892); Croasdale, Fresh Water Alg. Woods Hole, Mass., 21 (1935), in part. *S. Purcellii* W. R. Taylor,[1] Proc. Acad. Nat. Sci. Phila. **80**: 91, pl. 12, f. 7–9 (1928). *Symplocastrum Brittoniae* Gardn.,[2]

[1] I interpret the TYPE of this species in the Herb. W. R. Taylor, BRITISH COLUMBIA: red surface mud from nearly dried pool, parkland, Cañon Creek near Golden, *W. R. Taylor*, 2 Sept. 1923, as the juvenile state of *S. Friesii*. The typical symplocoid habit is not developed, but the filaments differ in no other respect from the authentic material of *S. Friesii* cited here.

[2] A study of the TYPE in the Herb. New York Bot. Gard. and an ISOTYPE in my own herbarium, PUERTO RICO: summit of El Yunque, Catalina-Yunque Trail, Luquillo Mountains, *E. G. Britton 7648*, 23–26 Feb. 1923, shows that, in spite of word to the contrary in the original description, the apical cells are conical and the sheaths are laminose, as in the authentic Gomontian specimens of *S. Friesii* cited here. On the average, in a large number of trichomes seen, the cells are no longer than those seen in *S. Friesii*. The errors in the description apparently arose from the poor state of preservation of many trichomes in the upper portions of the fascicles.

New York Acad. Sci., Sci. Surv. Porto Rico **8**(2): 287, pl. 2, f. 11 (1932). Authentic material: Desmaz., Pl. cryptog. France, éd. I, 1971 (F); Rabenh. Alg. 394 (F), 492 (T), 2364 (T), 2445 (T).—Infre-



quently encountered on soil and mosses in shady woods and along paths. Two specimens: FALMOUTH: Fay's Woods, Woods Hole, *W. G. Farlow*, July 1889 (F); earth by roadside, Nobska Woods, *J. E. Humphrey*, 22 July 1896 (W).

SCHIZOTHRIX PURPURASCENS (Kütz.) Gom., Ann. Sci. nat. VII Bot. **15**: 320, pl. ix, f. 6–8 (1892). Authentic material: Rabenh. Alg. 851 (N).—Two collections, the var. CRUENTA (Lespin.) Gom., ibid. 321: FALMOUTH: Town Playground, Woods Hole, *Drouet 2173*, 30 Aug. 1937 (D, S). TISBURY: subaerial in a springy meadow at upper end of Lake Tashmoo, *Drouet 1902*, 21 July 1936 (D, F, S, T, Y).

HYDROCOLEUM Kütz. ex Gom., Ann. Sci. nat. VII Bot. **15**: 332 (1892). *Hydrocoleus* Forti, Syll. Myxophyc. 315 (1907); Tilden, Minn. Alg. **1**: 134 (1910); Geitler, Rabenh. Kryptogamen-Fl. **14**: 1146 (1932). —Though Kützing, *Phycologia generalis*, 196 (1843), originally proposed this genus as Hydrocoleum and his orthography has been perpetuated by its use in Gomont's 'Monographie,' the masculine form of the name as written by Forti has been continued in no small part of the recent literature. The forms here considered are all marine plants of rather large dimensions. No specimens of freshwater species from southern Massachusetts have yet been seen.

KEY TO SPECIES

I. Plant-mass epiphytic on larger marine algae or growing on rocks in quiet salt water; trichomes usually less than 15 μ in diameter.—Plant-mass greenish or almost black, slimy, in mucous clumps on larger marine algae or in gelatinous strata on rocks; filaments parallel, often falsely branched; sheaths broad, mucous, acuminate or open at the apices, under certain conditions entirely diffluent; trichomes yellowish-green or blue-green, many within the sheath at the base of the filament, few in the branches, not constricted at the cross-walls, 8–16 (usually 9–11) μ in diameter; cells 1/3–1/6 as long as wide, 2.5–4.5 μ long; cross-walls granulated; apex of trichome attenuate-truncate. . *H. lyngbyaceum*

II. Plant-mass subaerial or aquatic, usually in brackish or quiet salt water; trichomes more than 15 μ in diameter.

A. Plant-mass brownish or greenish, forming gelatinous expansions on floating algae or subaerial on sand or other algae; sheaths very mucous, often entirely diffluent; trichomes pale green or brownish, not constricted at the cross-walls, 14–21 (usually 17–19) μ in diameter; cells 1/3–1/6 as long as wide; cross-walls granulated; apex of trichome briefly attenuate-truncate. . . . . *H. glutinosum*

B. Plant-mass brownish or blackish, phormidioid, mucous, or in drying almost chartaceous, indefinitely expanded, never caespitose, usually covering floating algae or aquatic plants in brackish water, sometimes subaerial; sheaths at first subamorphous, hyaline, thin, soon entirely diffluent; trichomes brownish or blue-green, not constricted at the cross-walls, 24–35 (usually 25–30) μ in diameter; cells 1/5–1/8 as long as wide; cross-walls granulated; apex of trichome briefly attenuated, the apical cell bearing a hemispherical calyptra. . . . . *H. Holdenii*

HYDROCOLEUM LYNGBYACEUM Kütz. ex Gom., Ann. Sci. nat. VII Bot. **15**: 337, pl. xii, f. 8, 9, 10 (1892); Setchell, Erythea **4**: 89 (1896), Phyc. Bor-Amer. **5**: 204 (1896); Collins, RHODORA **2**: 42 (1900); Davis, Bull. U. S. Bur. Fish. 1911(2): 797 (1913); Tilden, Minn. Alg. **1**: 136 (1910). Authentic material: Crouan, Alg. mar. Finistère **3**: 325 (F).—The typical variety occurs as greenish or blackish gelatinous masses on Ascophyllum, etc. in quiet salt water. Specimens seen: FALMOUTH: on Ascophyllum, Ram Island flats, Woods Hole, *M. Poole*, 17 Aug. 1936 (D, F, S, T, Y); Penzance Point, Woods Hole, *W. A. Setchell & W. J. V. Osterhout*, 30 Aug. 1894 (W); Woods Hole, *I. Holden*, 18 Aug. 1894 (F); on *Ascophyllum nodosum*, Wood's Hole, *W. A. Setchell*, 14 Aug. 1904 (Phyc. Bor.-Amer. 204, W, T, Y). GOSNOLD: south shore of Penikese Island, *J. G. Poole & Drouet*, 7 July 1930 (D).

HYDROCOLEUM GLUTINOSUM (Ag.) Gom. ex Ann. Sci. nat. VII Bot. **15**: 339 (1892); Collins, RHODORA **2**: 42 (1900); Davis, Bull. U. S. Bur. Fish. 1911(2): 797 (1913). *Lyngbya nigrescens* var. *major* Farlow, Mar. Alg. New Engl, 35 (1891), Alg. Am. Bor. Exs. **1**: 47. *L. aestuarii* f. *limicola* of Collins, Phyc. Bor.-Amer. **29**: 1402 (1907), in certain specimens, not Gom. *Oscillatoria margaritifera* of Taylor and Hazen

in Lewis, RHODORA **26**: 212, 215 (1924), in part, not Kütz. ex Gom. Authentic material: Crouan, Alg. mar. Finistère **3**: 328 (F).—*Fig. 2.* The typical variety is commonly found in blackish-green or brown sheets on sand or on algae floating in quiet salt or brackish water. This species and the next are often confused with *Oscillatoria margaritifera* and *O. Bonnemaisonii*, which they resemble superficially. Phyc. Bor.-Amer. 1402 is represented in the Herbarium of Yale University by an excellent specimen of *H. glutinosum*, and in the Herbarium of the Marine Biological Laboratory by typical *Lyngbya aestuarii*. Specimens seen: EASTHAM: on mud of a salt marsh, Bay shore, *F. S. Collins*, 10 Aug. 1897 (Phyc. Bor.-Amer. 1402, Y [not W]). FALMOUTH: on Vaucheria floating in Gardiner's Ditch, Woods Hole, *Drouet 1917*, 17 Aug. 1936 (D, F, S, T, Y); Wood's Holl, *W. G. Farlow*, 1875 (N); ad Zosteram et algas mortuas, Wood's Holl (Alg. Am. Bor. Exs. 47, F, Y); Gardiner's Ditch, Woods Hole, *Anon.*, 15 July 1931 (W); West Falmouth, *F. S. Collins* (F); in masses of dead floating Zostera and algae, Woods Hole, *W. G. Farlow*, Aug. 1875 (F). GOSNOLD: Botanical Survey of Penikese Island, 24 July 1923 (W).

HYDROCOLEUM HOLDENII Tilden, **descr. emend.** *H. Holdenii* Tilden, RHODORA **3**: 254 (1901); Minn. Alg. **1**: 137 (1910); Forti, Syll. Myxophyc. 319 (1907); Geitler, Rabenh. Kryptogamen-Fl. **14**: 1147 (1932). *H. majus* Holden, RHODORA **1**: 197, pl. 9, f. 7, 8 (1899), Phyc. Bor.-Amer. **13**: 602 (1899); Collins, RHODORA **2**: 42 (1900); not Martens. *Oscillatoria margaritifera* of Collins, Phyc. Bor.-Amer. 1708a, b (1911), not Kütz. ex Gom. *O. Bonnemaisonii* of Collins, ibid. 1707e (1911), not Crouan ex Gom. Stratum luteo-fuscum vel nigro-viride, phormidioideum, mucosum aut siccante fere papyraceo-chartaceum, indefinite expansum, haud caespitosum, vulgo algas majores et alias plantas aquaticas tectans, nonnumquam ad littora arenosa intra limites fluctuum maris subaeriale; vaginis initio subamorphis, hyalinis, plus minusve tenuibus, demum omnino diffluentibus, chlorozincico iodurato haud caerulescentibus; trichomatibus vivis luteo-fuscis vel aerugineis, ad genicula non constrictis, 24 μ ad 35 μ (vulgo 25 μ ad 30 μ) crassis, intra vaginas singulis binisve; articulis diametro trichomatis quintuplo ad octuplo brevioribus, 3.5 μ ad 4.5 μ longis; protoplasmate granuloso, dissepimentis grosse-granulatis; apice trichomatis breviter et leviter attenuata; cellula apicali calyptram hemisphaericam praebente (v. s., v. v.). *Fig. 3.*—In quiet brackish or salt water along the coast of New England. Specimens seen: MASSACHUSETTS: Eastham: in marshes, *F. S. Collins*, 13 July 1907 (Phyc. Bor.-Amer. 1708a, b, *specim. manca*, W, T, Y); among Calothrix, etc. in a salt marsh, *F. S. Collins*, July 1909 (Phyc. Bor.-Amer. 1707e, *specim. mancum*, W, T, Y). Falmouth: floating in a salt marsh at east side of Eel Pond, Woods Hole, *Drouet 1927*, 24 Aug. 1936 (D, F, S, T, Y); Gardiner's Ditch, Woods Hole, *Drouet 1946*, 17 Sept. 1936 (D, F). CONNECTICUT: on old Spartina stems in ditches of a salt marsh, Bridgeport, *I. Holden*, 24 May 1896 (Phyc. Bor.-Amer.

602, N, T, W, Y); Cook's Point, Bridgeport, *I. Holden*, 30 May 1896 (TYPE of *H. majus* Holden in Farlow Herb.). NEW YORK: on algae in pool in salt marsh, Cold Spring Harbor, *L. N. Johnson 1089*, July 1895 (F).

Doubts concerning the validity of this species have been raised by Geitler (ibid.). The material distributed by Holden in Phyc. Bor.-Amer. 602 is composed of badly shriveled trichomes which are often conspicuously torulose, a result, apparently, of the method of preparation of the exsiccata. The figure accompanying Holden's original description of *H. majus* must have been drawn from such dried material, since it is considerably at variance with the description. The type material in the Farlow Herbarium, however, contains few such shriveled trichomes and matches the written description exactly. This material, according to the herbarium label, grew in a salt marsh about the culms of Spartina, so that the stratum was apparently 'pierced' by these culms and became tubular (Geitler's 'röhrig') when the water level was lowered. Similar tubular growths are produced by this alga on Spartina culms during the dry season (when the water level is lowered by evaporation) in Gardiner's Ditch, a brackish marsh at Woods Hole. In the type material as well as in that of my own collecting, the range in size of trichomes is somewhat greater than that described by Holden. By actual experimentation I find that the trichomes, if dried very rapidly, retain the exact measurements characteristic of them in the living condition, despite Prof. Geitler's suggestion that in the material distributed in Phyc. Bor.-Amer. 602 "dieser Wert dürfte in Vergleich zur Breite des turgeszenten, kreisrunden Trichoms zu hoch sein." The trichomes referred to species of Oscillatoria in Phyc. Bor.-Amer. 1707e and 1708a & b are sheathed forms rather miserably preserved; though the plant-masses are in a very juvenile state, I cannot refer them to other than this species. *H. Holdenii*, like *H. glutinosum*, is a form with extremely diffluent sheaths inhabiting chiefly brackish water or muddy and sandy shores in the intertidal zone. From the latter species it differs in its greater trichomatal dimensions and in the presence of a hemispherical thickening of the outer wall of the apical cell.

MICROCOLEUS Desmaz. ex Gom., Ann. Sci. nat. VII Bot. **15**: 350 (1892).—I regret that I cannot admit to this list two species often encountered in fresh water in North America: *M. paludosus* (Kütz.) Gom. and *M. lacustris* Farl. ex Gom. Croasdale's reports of these in her *Fresh Water Alg. Woods Hole, Mass.*, 21 (1935), cannot be based

upon other than *M. chthonoplastes*, since the material was collected in brackish water of Gardiner's Ditch, Woods Hole; her specimens have been misplaced.

KEY TO SPECIES

I. Plant-mass subaerial or aquatic in brackish or salt water, rarely if ever in strictly fresh water; trichomes attenuate, conical or acuminate at the apices, never capitate
  A. Plant-mass yellowish or blackish-green, an extended stratified layer in or about brackish ponds or salt marshes; sheaths mucous, often entirely diffluent; trichomes bright blue-green, closely aggregated and numerous within the sheath, 2.5–6 μ in diameter, constricted at the cross-walls; cells subquadrate to twice as long as wide; cross-walls often granulated; apical cell acute-conical ..... *M. chthonoplastes*
  B. Plant-mass gray-green, or filaments mixed with other algae, usually in intertidal zones, seldom in brackish water; sheaths ample and mucous, often entirely diffluent; trichomes olive-green, more or less numerous within the sheath, conspicuously constricted at the cross-walls, 1.5–2 μ in diameter; cells 2.2–6 μ long; cross-walls pellucid, not rarely granulated; apical cell long-attenuate and very acutely conical ..... *M. tenerrimus*

II. Filaments subaerial or aerial on damp soil, rarely forming a black, tough, compact stratum; sheaths cylindrical, often entirely diffluent; trichomes green or olive-green, numerous and closely aggregated within the sheath, straight when escaped from the sheath, not at all constricted at the cross-walls, long-attenuate and capitate at the apices, 3.5–7 μ in diameter; cells subquadrate or half as long as wide, 3–7 μ long; cross-walls usually granulated; apical cell bearing a depressed-conical calyptra ..... *M. vaginatus*
Trichomes 4.4–6.5 μ in diameter, cells subquadrate or half as long as wide ..... var. *Vaucheri*

MICROCOLEUS CHTHONOPLASTES (Fl. dan.) Thur. ex Gom., Ann. Sci. nat. VII Bot. **15**: 353, pl. xiv, f. 5–8 (1892); Farlow, Alg. Am. Bor. Exs. **5**: 227 (1889), Mar. Alg. New Engl., 33 (1891); Collins, RHODORA **2**: 42 (1900); Tilden, Minn. Alg. **1**: 156 (1910); Davis, Bull. U. S. Bur. Fish. 1911 (2): 797 (1913). *Oscillatoria subtorulosa* of Davis, loc. cit. (1913), not Farl. apud Tild. *?M. lacustris* of Croasdale, Fresh Water Alg. Woods Hole, Mass., 21 (1935), not Farl. ex Gom. *?M. paludosus* of Croasdale, loc. cit. (1935), not Gom. Authentic material: Farl., Anders. & Eat., Alg. Am. Bor. Exs. 227 (F, Y).—Subaerial on intertidal flats and borders of salt marshes, often in masses of algae floating in brackish water, seldom and only accidentally in fresh water. Specimens seen: BOURNE: Red Brook, Pocasset, *H. Croasdale*, 12 Sept. 1934 (D). FALMOUTH: Penzance salt marsh, Woods Hole, *Drouet 1174* (D, F, S, T, Y), *1175* (D), 13 July 1934; Penzance Point, Woods Hole, *W. J. V. Osterhout*, 17 July 1895 (W, T); Wood's Holl, Aug. 1877 (F); Gardiner's Road Pond, Woods Hole, *W. R. Taylor*, 8 July 1917 (T); on mud, salt marshes, Woods Hole, *W. A. Setchell 816*, 16 Aug. 1894 (N); Wood's Holl, *W. G. Farlow*, Aug. 1877 (Alg. Am. Bor. Exs. 227,

F, Y); Falmouth, *F. S. Collins*, July 1880 (N); Shingle Pond, Gansett, *W. R. Taylor*, 30 June 1922 (T). GOSNOLD: salt marsh, Pasque Island, *C—C. Jao*, 26 June 1934 (D); salt marsh flats, e. end of Pasque Island, *W. R. Taylor*, 5 July 1932 (T, D).

MICROCOLEUS TENERRIMUS Gom., Ann. Sci. nat. VII Bot. **15**: 355, pl. xiv, f. 9–11 (1892); Davis, Bull. U. S. Bur. Fish. 1911(2): 797 (1913). *Oscillatoria amphibia* of Davis, ibid. 798 (1913), not Ag. ex Gom. Authentic material: Wittr. & Nordst., Alg. exs. 696 (F).—This species has apparently remained unrecognized by collectors because it is so seldom seen in pure strata; often it passes in American herbaria under the name of *Oscillatoria amphibia*. It has been reported from Maine by Collins, RHODORA **5**: 233 (1903); but Frémy, in a resume of the geographic distribution of the species in Bull. Soc. Linn. Normandie sér. 7, **7**: 181ff (1924), does not include the eastern coast of North America within its range. In the vicinity of Woods Hole, one finds the species sparingly among other subaerial Myxophyceae in salt marshes, on intertidal zones of shores, pilings, walls, etc. Specimens seen: FALMOUTH: subaerial on Grassy Island, Woods Hole, *Drouet 1886*, 17 July 1936 (D, F, S, T, Y, Frémy); pilings at entrance of Eel Pond, Woods Hole, *M. Thurlow*, 17 July 1936 (D); on woodwork, Woods Hole, *F. S. Collins*, 16 Aug. 1904 (sub. nom. *Oscillatoria amphibia*, N).

MICROCOLEUS VAGINATUS (Vauch.) Gom. var. VAUCHERI (Kütz.) Gom., Ann. Sci. nat. VII Bot. **15**: 356, pl. xiv, f. 12 (1892). Authentic material: Erbar. critt. ital. **10**: 485 (F); Rabenh. Alg. 353 (F).—Often encountered on soil and not seldom appearing in soil cultures. Dispersed trichomes found in soil samples have been mistaken for those of *Phormidium autumnale*. Specimens seen: FALMOUTH: on sandy bank by Quisset Avenue north of Golf Course, Woods Hole, *Drouet 1907*, 5 Aug. 1936 (D, F, T). TISBURY: on lawn about pumping station at Tashmoo Spring, *G. Velasquez & Drouet 1895*, 21 July 1936 (D, F, S, T, Y).

LYNGBYEAE

Kütz. emend. Gom., Ann. Sci. nat. VII Bot. 16: 91 (1892).

LYNGBYA Ag. ex Gom., idem, 118 (1892).—The inconstancy of the generic characters in the Oscillatoriaceae during the period of formation and development of hormogonia is well illustrated in many collections of species of Lyngbya. The tenacity of the sheath material in this genus is often so great that developing hormogonia in the lower parts of the sheath are observed to exert much pressure upon the cells of neighboring hormogonia and to produce in them a variety of anomalous shapes; in many instances, they grow in such a manner as to lie side by side and parallel with each other within the sheath, thus producing the habit of one of the Vaginarieae. In other cases, such great pressure may be exerted that a hormogonium may burst through the sheath and produce the effect of false branching in the filament as in the genus Plectonema.

KEY TO SPECIES

I. Filaments attached by a basal end to the substratum and usually growing perpendicular to it.—Filaments solitary, almost straight or subflexuous, epiphytic on other algae in brackish water; sheaths very thin, hyaline, not at all (or in our material, not readily) coloring blue when treated with chlor-zinc-iodine; trichomes blue-green, in our material somewhat constricted at the cross-walls, 1.8–2.8 μ in diameter, neither attenuate nor capitate at the apices; cells subquadrate or shorter than wide, 1–3 μ long; protoplasm coarsely granulose; cross-walls conspicuous, pellucid, not granulated; apical cell rotund, its outer membrane not at all thickened ..... *L. infixa*

II. Filaments attached to the substratum laterally, often throughout the entire length of the sheath.—Twining about other filamentous algae, principally in fresh water; filaments 1.5–2 μ in diameter; sheath thin, hyaline, not coloring blue when treated with chlor-zinc-iodine; trichomes pale blue-green, 1–1.5 μ in diameter, not constricted at the cross-walls, not attenuate at the apices; cells 1–2 μ long; protoplasm homogeneous; cross-walls not granulated; apical cell rotund ..... *L. epiphytica*

III. Filaments usually unattached to a substratum, or attached laterally by a portion of the sheath

A. Plants of marine or brackish water, not or rarely found in strictly fresh water

1. Trichomes 2 μ in diameter.—Filaments mixed with other algae in brackish water, usually short, more or less regularly spiraled, or often straight; sheaths thin, hyaline, coloring blue when treated with chlor-zinc-iodine; trichomes pale blue-green, about 2 μ in diameter, somewhat constricted at the cross-walls; cells 1.2–3 μ long; protoplasm finely granulose; cross-walls marked with two protoplasmic granules; apical cell rotund ..... *L. Lagerheimii*

2. Trichomes more than 2 μ in diameter

a. Sheaths not coloring blue when treated with chlor-zinc-iodine

(I) At least the older sheaths yellowish-brown.—Stratum brown or blue-green, subaerial or floating, sometimes forming symplocoid fascicles; sheaths at first hyaline, later colored yellowish-brown, often very thick and lamellose; trichomes blue-green or olive, at the apices often slightly attenuate-capitate and truncate, not constricted at the cross-walls, 8–24 μ in diameter; cells 1/3–1/6 as long as wide; protoplasm finely granulose; cross-walls granulated; outer membrane of apical cell conspicuously thickened ..... *L. aestuarii*

(II) Sheaths always hyaline

(A) Plant-mass extensive, dark blue-green, dull green, or yellowish-green; filaments crisp, elongate, variously intermeshed; sheaths very thick, to 11 μ wide, sometimes lamellose; trichomes blue-green, brownish, or grayish-green, not constricted at the cross-walls, not attenu-

ated at the apices, 16–60 μ in diameter; cells 1/6–1/15 as long as wide; protoplasm finely granulose; cross-walls never granulated; apical cell rotund, without calyptra.....*L. majuscula*

(B) Plant-mass expanded, slimy, brownish, dark green, or blackish, usually with a violet tinge in drying, or forming a pannose stratum; filaments elongate, straight, subrigid; sheaths lamellose, to 5 μ thick; trichomes olive or blue-green, often violet in dried material, not constricted at the cross-walls, not attenuated at the apices, 9–25 (in our material 9–12) μ in diameter; cells 1/3–1/8 as long as wide; protoplasm finely granulose; cross-walls granulated; apical cell rotund, without a calyptra.....*L. confervoides*

(C) Plant-mass expanded, mucous, usually dull yellow-green or obscurely blue-green, sometimes forming a pannose stratum; filaments not rigid or straight, always flexuous; sheaths lamellose, to 3 μ thick; trichomes yellowish-green, olive, or blue-green, somewhat attenuate and capitate at the apices, not constricted at the cross-walls, 5–12 μ in diameter; cells 1/3–1/6 as long as wide; protoplasm finely granulose; cross-walls frequently granulated; membrane of the apical cell thickened into a distinct depressed-conical or rotund calyptra...*L. semiplena*

b. Sheaths coloring blue when treated with chlor-zinc-iodine.—Stratum subgelatinous, coriaceous, yellowish-brown or olive, in drying often dark violet; filaments contorted, much intertwined; sheaths hyaline, at first thin, later to 3 μ thick and lamellose; trichomes olive-green, not constricted at the cross-walls, not attenuated at the apices, 2.5–6 μ in diameter; cells quadrate to 1/3 as long as wide; protoplasm granulose; cross-walls conspicuous, sometimes granulated; membrane of the apical cell thickened into a rotund calyptra.....*L. lutea*

B. Plants of fresh water exclusively.—Plant-mass a fragile, scarcely gelatinous stratum, intensely yellowish-brown; filaments short, stiff, more or less curved; sheaths at first thin and hyaline, later thick and opaque-brown, not coloring blue when treated with chlor-zinc-iodine; trichomes blue-green, often torulose, 0.9 μ in diameter; cells shorter than wide, 0.6–0.8 μ long; cross-walls not granulated; apical cell rotund....*L. ochracea*

LYNGBYA INFIXA Frémy, Compt. Rend. Acad. Sci. Paris **195**: 1414 (1932); Mém. Soc. nat. Sci. nat. & math. Cherbourg **41**: 110, pl. 30, f. 1 (1934).—*Fig. 4.* I place the material cited below[1] in this species

[1] I cannot but suspect that this material should more properly be considered the juvenile form of *L. Digueti* Gom. in Hariot, Journ. de Bot. **9**: 169 (1895), as repre-

at the suggestion of Prof. Frémy, even though the sheaths become definitely blue when treated with chlor-zinc-iodine and the trichomes are slightly constricted at the cross-walls. These characters are not preserved well in my collections *1126* and *1134* cited below because the greater number of specimens were prepared for distribution from material immersed for more than a year in 2% formalin. Specimens seen: GOSNOLD: in a boggy salt marsh on north shore of Pasque Island, *Drouet 1126*, 26 June 1934 (D); on Cladophora, Pasque Island, *Drouet 1132*, 26 June 1934 (D, F, T, W, Y). OAK BLUFFS: growing on Cladophora, Cottage City, *F. S. Collins*, 19 Sept. 1883 (sub. nom *Leibleinia* sp., N).

LYNGBYA EPIPHYTICA Hieron. apud Lemmermann, Ark. f. Bot. **2**(2): 103 (1904); Forti, Syll. Myxophyc., 289 (1907). Hieron. *nomen subnudum* in Kirchn., Schizophyc., 67 (1900);—Epiphytic on freshwater algae, especially upon large sheathed Hormogoneales. Specimens seen: FALMOUTH: on *Dichothrix* sp. on a submerged piece of tile, Salt Pond, *E. T. Rose*, 19 June 1936 (D); on *Scytonema* sp., Silver Beach Pond, West Falmouth, *H. Croasdale*, 1 Sept. 1933 (D, F, T).

LYNGBYA LAGERHEIMII (Möb.) Gom., Ann. Sci. nat. VII Bot. **16**: 147, pl. iv, f. 6, 7 (1892); Setchell, Bull. Torr. Bot. Club **22**: 430 (1895); Tilden, Minn. Alg. **1**: 111 (1910); Davis, Bull. U. S. Bur. Fish. 1911(2): 798 (1913); Croasdale, Freshwater Alg. Woods Hole, Mass., 20 (1935). —*Fig. 5.* Usually found in muck on the bottoms of subsaline ponds, often mixed with other algae. Filaments are not abundant in any of the specimens examined:[1] FALMOUTH: in a slightly brackish marsh about Chara Pond, *Drouet 1860*, 20 June 1936 (D); in brackish water, Little Pond, *W. A. Setchell & W. J. V. Osterhout*, 17 Aug. 1895 (W). GOSNOLD: Dune Pond, Nashawena Island, *Drouet 1167*, 3 July 1934 (D).

LYNGBYA AESTUARII (Mert.) Liebm. ex Gom., Ann. Sci. nat. VII Bot. **16**: 127, pl. iii, f. 1, 2 (1892); Farlow, Mar. Alg. New Engl., 34 (1891); Collins, RHODORA **2**: 42 (1900), Phyc. Bor.-Amer. **21**: 1009 (1903), ibid. **29**: 1402 (1907), in certain specimens; Tilden, Minn. Alg. **1**: 121 (1910); Davis, Bull. U. S. Bur. Fish. 1911(2): 798 (1913); Taylor in Lewis, RHODORA **26**: 212 (1924); Hazen in Lewis, RHODORA **26**: 215 (1924); Croasdale, Fresh Water Alg. Woods Hole, Mass., 21

---

sented in Wittrock & Nordstedt, *Algae Exsiccatae* 1522a and b from Sweden. This species is described in the Myxophycean manuals now in vogue as possessing lateral attachment of the filaments; although there is nothing in Gomont's description or in Wittrock & Nordstedt, *Algae Exsiccatae* 1522a–c, determined by M. Gomont, to lead us to believe that the attachment is not basal.

[1] My conception of this species has been based solely upon the descriptions and figures in Gomont's 'Monographie' and in Möbius, Hedwigia **28**: 312 (1889), and upon such presumably unauthenticated specimens as Phyc. Bor.-Amer. 53 and 1008. In a recent comparative study of the herbarium material which I have included in this species, I find one specimen, PARÁ: on Utricularia in fish ponds, Museu Paraense, Belém, *Drouet 1275*, 27 June 1935 (D, F, N, S, Y, Herb. Univ. Mich., Rijksherb. at Leiden, Mus. Nac. at Rio de Janeiro) distributed as *L. Lagerheimii* and noted as such in my article, The Brazilian Myxophyceae, I, Amer. Journ. Bot. **24**: 604 (1937), to be referable to *L. Digueti* Gom. (see footnote 9 of this paper).

(1935). *L. ferruginea* of Farlow, Rept. U. S. Fish Comm. 1875: 24 (1876). Authentic material: Rabenh. Alg. 773 (F), 2055 (F, T).—*F. limicola* Gom., f. *natans* Gom., f. *symplocoidea* Gom., f. *ferruginea* (Ag.) Gom., and f. *aeruginosa* (Ag.) Wolle ex Gom., ibid. 129, 130 (1892), appear in the southern Massachusetts region to be rather ecological variations of a single variable species than distinguishable taxonomic entities. The species is the commonest of the Lyngbyas in brackish and salt water; it is the chief constituent of the extensive subaerial growths of Myxophyceae on mud of salt marshes. In none of our specimens is the sheath colored blue when treated with chlor-zinc-iodine as described for *L. stagnina* Kütz. ex Gom. (pro synon. *L. aestuarii*) by Lemmermann, Forschungsber. biol. Sta. Plön **12**: 145 (1905), and by Boye-Petersen, Bot. Icel. **2**(2): 285, f. 6 (1928). Specimens examined: EASTHAM: salt marsh, Bay shore, *F. S. Collins*, 10 Aug. 1907 (Phyc. Bor.-Amer. 1402, W, T, not Y). FALMOUTH: subaerial, Penzance salt marsh, Woods Hole, *Drouet 1892*, 19 July 1936 (D), *Drouet 1178*, 13 July 1934 (D, Y); Gansett Pond No. 2, *W. R. Taylor*, 6 July 1917 (T); Falmouth, *F. S. Collins*, July 1880 (F); Penzance Point, *R. A. Esten*, 5 July 1893 (W); Park Ditch, Woods Hole, *E. T. Rose*, 22 July 1936 (D); Siders Pond, *H. Croasdale*, 6 Aug. 1930 (D); Wood's Holl, *Herb. C. L. Anderson* (N). MATTAPOISETT: on Spartina, *F. S. Collins*, 14 Sept. 1902 (N; Phyc. Bor.-Amer. 1009, W, T, Y). GOSNOLD: Nonamesset Island, *E. T. Rose*, 29 June 1936 (D, F, T); Deer Pond, Nonamesset Island, *H. Croasdale*, 2 July 1934 (D, N, S); Botanical Survey of Penikese Island, 24 July 1923 (W); brackish pools, Naushon Island, *Anon.*, July 1908 (W); Shore Pond, Tarpaulin Cove, *W. R. Taylor*, 4 Aug. 1927 (T). EDGARTOWN: mats over decaying Zostera leaves in a salt marsh, *M. A. Howe*, 8–18 Aug. 1900 (N).

LYNGBYA MAJUSCULA (Dillw.) Harv. ex Gom., Ann. Sci. nat. VII Bot. **16**: 131, pl. iii, f. 3, 4 (1892); Farlow, Rept. U. S. Comm. Fish & Fisheries 1871–72: 293 (1873), Proc. Amer. Acad. **10**: 380 (1875), Rept. U. S. Fish Comm. 1875: 24 (1876); Collins, Alg. Am. Bor. Exs. **5**: 228 (1889); Farlow, Mar. Alg. New Engl., 34 (1891); Setchell, Phyc. Bor.-Amer. **5**: 202 (1896); Collins, RHODORA **2**: 42 (1900); Tilden, Minn. Alg. **1**: 123 (1910); Davis, Bull. U. S. Bur. Fish. 1911(2): 798 (1913); Croasdale, Fresh Water Alg. Woods Hole, Mass., 21 (1935). Authentic material: Rabenh. Alg. 588 (T); Harv., Friendly Ids. Alg. 120 (F), 121 (F); Harv., Ceylon Alg. 84 (F).—This species, usually found only in marine waters, is often confused, as Geitler has pointed out in Rabenh. Kryptogamen-Fl. **14**: 1060 (1932), with the strictly freshwater *Plectonema Wollei* Farl. ex Gom. In the Woods Hole region, *L. majuscula* is usually washed ashore in large clumps; less often it is seen as extended strata on mud in quiet salt water. Specimens seen: BOURNE: Scraggy Neck, *A. M. Russell*, 13 Aug. 1917 (T); Pocasset, *M. Sumwalt*, 25 July 1925 (T). FALMOUTH: Nobska, *W. G. Farlow* (F); Bay traps, Woods Hole, *Anon.*, 30 Aug. 1932 (D); Little

Harbor, Woods Hole, *Anon.*, 20 June 1931 (W); Wood's Hole, *B. L[ivingston]*, Aug. 1875 (D, F, T, Y); Woods Holl, *R. A. Esten*, July 1893 (W); washed ashore, Wood's Hole, *W. A. Setchell*, 16 Aug. 1894 (Phyc. Bor.-Amer. 202, N, T, W, Y); Woods Holl, *Herb. A. B. Hervey 9* (N); Falmouth, *G. W. Perry*, 22 Aug. 1882 (N); Falmouth, *F. S. Collins*, July 1880 (F); Falmouth, *Anon.*, July 1882 (T); floating, Woods Holl, *W. A. Setchell*, 18 July 1890 (F, N); Wood's Hole, *D. C. Eaton*, Aug. 1871 (Y); Woods Hole, *I. Holden*, 17 Aug. 1894 (F, N); Vineyard Sound, *W. G. Farlow* (F); Juniper Point, Woods Hole, *W. R. Taylor*, 9 Aug. 1928 (T); Meganset Beach, North Falmouth, *W. R. Taylor*, 21 July 1931 (T, D). TISBURY: Vineyard Haven, *F. S. Collins* (W), Sept. 1883 (Alg. Am. Bor. Exs. 228, D, F, Y). OAK BLUFFS: Highlands, *C. C. Curtis*, 11 July 1892 (N). EDGARTOWN: floating in its harbor, *M. A. Howe*, 8 Aug. 1900 (N). MATTAPOISETT: *G. W. Perry*, 19 Aug. 1884 (N).

LYNGBYA CONFERVOIDES Ag. ex Gom., Ann. Sci. nat. VII Bot. **16:** 136, pl. iii, f. 5, 6 (1892); Collins, RHODORA **2:** 42 (1900); Tilden, Minn. Alg. **1:** 119 (1910); Davis, Bull. U. S. Bur. Fish. 1911(2): 798 (1913). *L. lutco-fusca* of Farlow, Rept. U. S. Fish Comm. 1875: 24 (1876), Alg. Am. Bor. Exs. **1:** 48, Mar. Alg. New Engl., 35 (1891). *L. semiplena* of Setchell, Phyc. Bor.-Amer. **30:** 1452b (1908), not of Nott, ibid. 1452a; Tilden, Minn. Alg. **1:** 118 (1910), in part; Croasdale, Fresh Water Alg. Woods Hole, Mass., 20 (1935), in part; not J. Ag. ex Gom. Authentic material: Farl., Anders. & Eat., Alg. Am. Bor. Exs. 48 (F, N, Y); Hohenack. Meeresalg. 500(T).—Found on intertidal zones of wharf pilings, rocks, and shores, also in tide pools. New England material rarely exceeds 12 μ in trichomatal diameter. I have been unable to locate the specimens from brackish water of Chara Pond reported by Croasdale, ibid. 21 (1935). Specimens seen: FALMOUTH: with *L. majuscula*, Meganset Beach, North Falmouth, *W. R. Taylor*, 21 July 1931 (T, D); Little Harbor, Woods Hole, *G. J. Hollenberg*, 27 July 1934 (D), *W. A. Setchell*, 18 Aug. 1894 (Phyc. Bor.-Amer. 1452b, W, T, Y), *H. Croasdale*, 30 July 1934 (D, F, T); on government wharf, Woods Holl, *W. G. Farlow*, Aug. 1876 (F); ad lapides et saepes, Wood's Holl, *W. G. Farlow* (Alg. Am. Bor. Exs. 48, F, N, Y). NO MAN'S LAND: *W. R. Taylor 17035*, 16 Aug. 1932 (T, D).

LYNGBYA SEMIPLENA (Ag.) J. Ag. ex Gom., Ann. Sci. nat. VII Bot. **16:** 138, pl. iii, f. 7–11 (1892). Not *L. semiplena* of Nott, Phyc. Bor.-Amer. **30:** 1452a (1908), nor of Setchell, idem 1452b (1908); not of Tilden, Minn. Alg. **1:** 118 (1910), at least as to southern Massachusetts specimens; not of Davis, Bull. U. S. Bur. Fish. 1911(2): 798 (1913); not of Croasdale, Fresh Water Alg. Woods Hole, Mass., 20 (1935). Authentic material: Wittr. & Nordst., Alg. exs. 280 (F); Hauck & Richt., Phyk. univ. 328 (F).—Found in the same type of habitat as *L. confervoides* and often mixed with it; often collected in brackish water. Phyc. Bor. Amer. 1452a is treated in the present paper as *Phormidium ambiguum*, 1452b as *L. confervoides;* Davis' uncertain

material is referred to under *Symploca atlantica*. Specimens seen: FALMOUTH: on wooden piers, Little Harbor, Woods Hole, *Drouet 1923*, 20 Aug. 1936 (D, F, S, T, Y); on wood submerged in Mill Pond, Woods Hole, *Drouet 1929*, 25 Aug. 1936 (D, F); on Zostera in Eel Pond, *Drouet 1014*, 15 July 1930 (D).

LYNGBYA LUTEA (Ag.) Gom. ex Ann. Sci. nat. VII Bot. **16:** 141, pl. iii, f. 12, 13 (1892); Collins, Phyc. Bor.-Amer. **32:** 1611 (1910), in minor part. *L. tenerrima* Born. ex Gom. *pro synon.*, loc. cit. (1892); Thur. ms. in Farlow, Mar. Alg. New Engl., 35 (1891), sec. specim. authent. in Herb. Farlow.—Our material is very similar to that distributed from Herb. Thuret in the Farlow Herbarium: FRANCE: Biarritz, *No. 55*, 10 juin 1870. This species is found in situations similar to those in which *L. confervoides* and *L. semiplena* are found; it is easily distinguished from the two latter species by the smaller trichomatal size and the reaction of the sheath to chlor-zinc-iodine. The filaments referred to as *L. lutea* in Phyc. Bor.-Amer. 1611 are few and very doubtful. Specimens seen: EASTHAM: 'Sunken Meadow,' *F. S. Collins*, 13 Sept. 1909 (Phyc. Bor.-Amer. 1611, in minor part, *specim. manca*, W, T, Y). FALMOUTH: on rocks at outlet of Oyster and Chara Ponds into Vineyard Sound, *Drouet 2172*, 29 Aug. 1937 (D, F, N, S); in drain of Supply Department Building, Woods Hole, *Drouet 1913*, 13 Aug. 1936 (D, F, S, T, Y); on pilings, Penzance Garage, Woods Hole, *G. J. Hollenberg*, 27 July 1934 (D).

LYNGBYA OCHRACEA (Kütz.) Thur. ex Gom., Ann. Sci. nat. VII Bot. **16:** 149 (1892). Authentic material: Rabenh. Alg. 58 (F), 2333 (F).—Observed in varying abundance in freshwater pools, etc. See Geitler, Rabenh. Kryptogamen-Fl. **14:** 1050 (1932). Specimens seen: FALMOUTH: in pool across road from entrance to Cedar Swamp, Woods Hole, *Drouet 1957*, 15 Sept. 1936 (D, F, S, T, Y). GOSNOLD: in spring water flowing into Cuttyhunk Pond, Cuttyhunk Island, *Drouet 2120*, 3 Aug. 1937 (D, F, N, S).

SYMPLOCA Kütz. ex Gom., Ann. Sci. nat. VII Bot. **16:** 104 (1892). —The fascicles of filaments produced on the surface of the plant mass in this genus are not always macroscopically visible. Perhaps in the majority of collections the fascicles are microscopic bundles of filaments either standing upright or closely appressed to the surface of the stratum. If the plant-mass has developed entirely beneath the surface of the water, it is improbable that fascicles will be formed at all; they are recognized only after the mass has developed, at least for a certain period of time, under subaerial conditions.

KEY TO SPECIES

I. Plants of salt or brackish habitats
   A. Plant-mass blackish-green, fasciculate-caespitose; fascicles erect, to 1 cm. high; filaments apparently unbranched, very closely intricated, often angulose-tortuose; sheaths thin, firm, coloring blue when treated with chlor-zinc-iodine; trichomes yellowish-green or

blue-green, 4–6 μ in diameter, always constricted at the cross-walls; cells usually quadrate or shorter than wide; protoplasm scarcely granulose; cross-walls pellucid, never granulated; outer membrane of the apical cell thickened into a depressed-conical calyptra..... *S. atlantica*

B. Plant-mass dirty green, rarely bluish-black, fasciculate-caespitose; fascicles to 3 cm. high, erect, spiniform, often discolored below because of empty sheaths; filaments compactly interwoven, somewhat agglutinated, here and there falsely branched, variously angulose-tortuose; sheaths thin, somewhat mucous, not readily coloring blue when treated with chlor-zinc-iodine; trichomes blue-green, 6–14 μ in diameter, often torulose at the apices; cells somewhat longer than the diameter or (in broader trichomes) half as long as wide, 5–14 μ long; protoplasm granulose, cross-walls often granulated; apical cell slightly inflated, without calyptra.... *S. hydnoides*

1. Trichomes 6–8 μ in diameter, cells as long as or longer than wide..... var. *genuina*
2. Trichomes 8–14 μ in diameter, cells subquadrate to half as long as wide..... var. *fasciculata*

II. Plants of fresh, not of salt or brackish, habitats

A. Plant-mass blackish-blue-green, expanded; fascicles spiniform, to 2 mm. high; filaments unbranched, at the base contorted and irregularly interwoven, in the fascicles more or less parallel and agglutinated; sheaths firm, thin, somewhat mucous, coloring blue when treated with chlor-zinc-iodine; trichomes bright blue-green, never constricted at the cross-walls, slightly attenuated at the apices, 3.4–4 μ in diameter; cells subquadrate or somewhat longer or shorter than wide, 1.5–5.5 μ long; cross-walls conspicuous, never granulated; apical cell obtuse-conical, without calyptra..... *S. muralis*

B. Plant-mass blue-green, grayish, brown, or blackish, phormidioid or fasciculate, sometimes giving a cottony appearance on damp ground; fascicles tortuous, repent, rarely erect; filaments seldom branched, tortuous, much entangled in the basal stratum, in the fascicles less tortuous and often subparallel; sheaths firm or sometimes mucous, coloring blue when treated with chlor-zinc-iodine, up to 2 μ in thickness; trichomes blue-green or olive-green, never constricted at the cross-walls, 5–8 μ in diameter; cells subquadrate to twice as long as wide, 5–11 μ long; protoplasm coarsely granulose; cross-walls not conspicuous, never granulated; apical cell rounded or obtusely conical, the outer membrane slightly thickened..... *S. Muscorum*

SYMPLOCA ATLANTICA Gom., Ann. Sci. nat. VII Bot. **16:** 109, pl. ii, f. 5 (1892). *Lyngbya semiplena* of Davis, Bull. U. S. Bur. Fish. 1911 (2): 798 (1913), not J. Ag. ex Gom. *S. Muscorum* of Croasdale, Fresh Water Alg. Woods Hole, Mass., 19 (1935), not Gom.—This is an inhabitant of wood and rock walls sometimes washed by waves. Our material has the short articulations and the depressed-conical calyptras of the European plant and is not to be confused with *S. funicularis* Setch. & Gardn., Univ. Calif. Publ. Bot. **6:** 469 (1918), as

distributed under the name *S. atlantica* in Phyc. Bor.-Amer. 1356. Material from my collection *1922* cited below has been compared with authentic specimens by Prof. Frémy. *S. atlantica* may sometimes be confused with *Phormidium submembranaceum*, which often is collected also on rocks and woodwork washed by waves. Specimens seen: FALMOUTH: subaerial on floating wooden piers beside U. S. Lighthouse Service Building, Woods Hole, *Drouet 1922*, 20 Aug. 1936 (D, F, S, T, Y, Frémy); Eel Pond, Woods Hole, *F. S. Collins*, 16 Aug. 1904 (sub. nom. *Lyngbya semiplena*, etc., F); subaerial at high tide mark on concrete walls of Supply Department Building, Woods Hole, *Drouet 1914*, 13 Aug. 1936 (D); subaerial, Gardiner's Ditch, Woods Hole, *Drouet 1015*, 20 July 1930 (*specim. mancum*, D).

SYMPLOCA HYDNOIDES Kütz. ex Gom., Ann. Sci. nat. VII Bot. **16:** 106, pl. ii, f. 1–4 (1892); Collins, RHODORA **2:** 42 (1900). *Phormidium pulvinatum* Collins[1] in Britton & Millspaugh, Bahaman Fl., 621 (1920), not Woronich. Authentic material: Desmaz., Pl. cryptog. France, éd. I, 1972 (F).—The var. GENUINA Gom. is seen mixed with other Myxophyceae in intertidal zones and salt marshes, the var. FASCICULATA (Kütz.) Gom. on larger algae in quiet salt water. Specimens seen: FALMOUTH: Menauhant, *F. S. Collins*, July 1882 (N). GOSNOLD: on mud among Spartina roots, Naushon Island, *W. A. Setchell*, 16 July 1891 (sub. nom. *S. fasciculata*, N); Hadley Harbor, Naushon Island, *W. R. Taylor*, 11 July 1931 (T, D), *Anon.*, 12 July 1931 (Herb. G. W. Prescott), *C. M. Palmer*, 28 Aug. 1937 (D, N, S).

SYMPLOCA MURALIS Kütz. ex Gom., Ann. Sci. nat. VII Bot. **16:** 112, pl. ii, f. 10 (1892); Setchell, Bull. Torr. Bot. Club **22:** 429 (1895); Croasdale, Fresh Water Alg. Woods Hole, Mass., 19 (1935). Authentic material: Rabenh. Alg. 142 (F), 293 (F).—Apparently not uncommon in the region on moist soil and among mosses. In rapidly growing plant masses, the cells are often somewhat longer than wide. Where the fascicles are not well developed, masses may be difficult to distinguish from those of *Phormidium Corium* and *P. papyraceum*. Specimens seen: FALMOUTH: on the ground around the railroad well, Wood's Holl, *W. G. Farlow*, Aug. 1876 (F, P); on ground near a pump, East Falmouth, *W. A. Setchell 340*, 12 July 1891 (D, duplicate of specimen in Herb. Univ. Calif., obligingly sent to me by Prof. Setchell); sandy path, Woods Hole, *Collins 5150*, 16 Aug. 1904 (sub. nom. *S. Muscorum*, N); earth, Quisset Road, *W. R. Taylor*, 9 July 1922 (T). FAIRHAVEN: on wet soil among rocks, Sconticut Point, *Drouet 2174*, 1 Sept. 1937 (D, F, S, N, T).

SYMPLOCA MUSCORUM (Ag.) Gom. ex Ann. Sci. nat. VII Bot. **16:** 110, pl. ii, f. 9 (1892); not of Croasdale, Fresh Water Alg. Woods

[1] The TYPE material of *P. pulvinatum* Collins, BAHAMA ISLANDS: Cockburn Harbor, South Caicos, *M. A. Howe 5593*, 16 Dec. 1907, in Herb. New York Bot. Gard., differs in no respect from the authentic material of *S. hydnoides* cited here. *P. pulvinatum* Woronich. is now more properly designated *P. Woronichinii* J. DeToni, *Noterelle di nomencl. algol. I. Alcuni casi di omonimia* (*Missoficee*), 7 (1934).

Hole, Mass., 19 (1935). *Phormidium Retzii* of Croasdale, ibid. 20 (1935), not Gom. Authentic material: Rabenh. Alg. 244 (F), 929 (T). —Frequently seen on moist soil in depressions and in greenhouses, sometimes among other submersed algae in ponds. Plant-masses having the described characters of f. *genuina* Gom. apud Frémy and f. *inundata* Gom. apud Frémy, Mém. Soc. nat. Sci. nat. & math. Cherbourg **41**: 83 (1934), are collected in the Woods Hole region; but material of both forms appears to develop fascicles in exactly the same manner when transferred to the laboratory and grown under subaerial conditions. Specimens seen: MASHPEE: in John Pond, *C. M. Palmer*, Sept. 1937 (D). FALMOUTH: on soil in greenhouse near railroad station, Falmouth, *Drouet 1933*, 29 Aug. 1936 (D, F); on soil in a pasture, Sippewisset, *Drouet 1935*, 4 Sept. 1936 (D, F, S, T, Y); on soil in a depression east of Iron Pond, Woods Hole, *Drouet 1938*, 12 Sept. 1936 (D, T); in spring north of Nobska Point, *C. M. Palmer*, Sept. 1937 (D). GOSNOLD: freshwater pond, Pasque Island, *H. Croasdale*, 26 June 1934 (D); Pink Pond, Nonamesset Island, *H. Croasdale*, 2 July 1934 (D).

(*To be continued*)

WESTERN EXTENSION OF THE RANGE OF PINUS BANKSIANA IN NEW YORK

W. F. Pratt and E. W. Littlefield

For the past thirty years or more the known distribution of *Pinus Banksiana* in New York has been confined to certain portions of the Lake Champlain watershed in Clinton and Essex counties. No stations have been reported, during this time, which would materially extend the range as outlined by the early observations of Sears[1] and Peck.[2] House[3] lists *Pinus Banksiana* as "rare" in northern New York, citing the stations reported by Peck in the Ausable and Bouquet valleys. The junior writer[4] described the association of this species with *Pinus rigida* Mill. at Clintonville, Essex County, and has noted its occurrence in a number of other unreported localities, all however, within the general limits of the range as indicated above.

In the summer of 1931, the senior writer discovered a group of *Pinus Banksiana* growing on a sandy knoll along the east bank of the Deer River in the Town of Brasher in eastern St. Lawrence County,

[1] Bull. Essex Inst. 13 (1881) pp. 174–178.
[2] N. Y. State Museum Vol. V. No. 25 (1898).
[3] N. Y. State Museum No. 254 (1924).
[4] Littlefield: Rhodora xxx (1928) pp. 129–131.